

REMARKS

This amendment is responsive to the Office Actions of April 18, 2006. Reconsideration and allowance of claims 1-14 are requested.

The Office Action

Claims 1 and 11 stand rejected under 35 U.S.C. § 102 as being anticipated by Hoshino (US 5,122,749), Van Hellsbergen (US 5,861,749), or Visser (US 6,870,368).

Claims 2 and 3 stand rejected under 35 U.S.C. § 102 as being anticipated by Van Hellsbergen or Visser.

Claims 4 and 5 stand rejected under 35 U.S.C. § 112, second paragraph, and under 35 U.S.C. § 102 as being anticipated by Visser.

Claims 6-10 stand rejected under 35 U.S.C. § 102 as being anticipated by Visser.

The Present Application

The present application discloses a magnetic resonance imaging apparatus for use with parallel imaging techniques such as SENSE or SMASH in which at least two RF coils are selected so as to provide maximum spatially varying coil sensitivities along the principal axis for coil sensitivity encoding. The output of each of two pairs of RF coils is combined to generate a pair of output signals. Further, the outputs of two or more of the other output RF coils are not combined, but are connected directly to their own receiver channel. This results in a better signal-to-noise ratio.

Rule 131 Affidavit

The Visser patent has an effective filing date of February 5, 2002; whereas, the present application has an effective filing date of June 21, 2002. As evidenced by the attached Invention Disclosure document which was prepared by the inventor herein and dated prior to the effective filing date of the Visser patent, the present inventor conceived of the invention claimed in this application prior to the effective filing date of the Visser reference. The applicants have blacked out date information from the enclosed Invention Disclosure.

The inventor is currently on holiday and not available to review a 37 CFR 1.131 Affidavit. The undersigned plans to obtain inventor review of such an affidavit when he returns and to submit the affidavit as a supplemental submission.

If the Examiner should pick up this amendment for action before the 37 CFR 1.131 Affidavit is submitted, the applicants assert that upon a careful and detailed reading of the present claims and the Visser reference, the Examiner will note numerous distinctions, i.e., it is not an anticipatory reference as the Examiner has alleged.

**The Claims Distinguish Patentably
Over the References of Record**

Claim 1 calls for an RF coil system for detecting coil sensitivity encoded RF signals. Hoshino is directed to a linear array of coils for spine imaging and makes no suggestion of using the coils for detecting coil sensitivity encoded RF signals, that it would be in any way advantageous to do so, or how the Hoshino patent would need to be modified to generate images from sensitivity encoded RF signals. Van Hellsbergen is also directed to linear, one-dimensional arrays of surface coils (column 3, lines 37-39 and 64). Van Hellsbergen makes no suggestion of detecting coil sensitivity encoded RF signals, provides no motivation to do so, and fails to teach or fairly suggest how one would modify the Van Hellsbergen scanner in order to process such signals into an image.

Claim 1 further calls for at least two RF coils to provide maximum spatially-varying coil sensitivities along the principle axis for coil sensitivity encoding. Because neither Hoshino nor Van Hellsbergen are directed to coil sensitivity encoded RF systems, neither has a principal axis for coil sensitivity encoding nor an arrangement which provides maximum spatially-varying coil sensitivities.

Claim 1 further calls for the RF coils to be disposed circumferentially around the region of interest. By contrast, both Hoshino and Van Hellsbergen disclose linear array coils.

Accordingly, it is submitted that **claim 1** is not anticipated by and distinguishes patentably over the references of record.

Claim 2 has been placed in independent form. **Claim 2** calls for pairs of RF coils, each pair of RF coils being combined and connected to a separate receiver

channel. **Claim 2** further calls for at least one RF coil which is not combined with any other RF coil. By contrast, the applied references combine a plurality of RF coils into each receiver channel.

Hoshino has a signal composer or preprocessor **31** which receives signals from the odd-numbered RF coils and generates one signal based on these input signals and a second unit **32** which receives signals from the even-numbered coils and generates a signal based on these inputs (column 2, lines 46-54). The output of signal composers or preprocessors is a signal which is sent to each of receivers **31b, 32b**. Thus, Hoshino combines the outputs of even coils or odd coils rather than pairs of RF coils. Further, Hoshino makes no suggestion of an RF coil which is not combined with any other RF coil.

Similarly, in Van Hellsbergen, pairs of the RF coils **33** are phase-shifted **41** and combined **43a, 43b, 43c**. Van Hellsbergen also suggests an unillustrated alternate embodiment in which each adding unit combines the outputs of three coils (column 4, lines 60-65). However, Van Hellsbergen fails to suggest combining the surface coils in groupings of different sizes, much less combining some coils in pairs and not combining some coils with any other RF coil. Accordingly, it is submitted that **claim 2 and claims 3-10, 12, and 13 dependent therefrom** are not anticipated by any reference of record.

Claim 11 is directed to a magnetic resonance imaging method in which at least two RF coils are combined with each other and connected to a single one of the receiver channels and at least one other of the RF coils is not combined with any other RF coil and is connected to another one of the receiver channels. Hoshino combines even signals together and provides them to one of the receiver channels and odd signals together which are sent to a second receiver channel. Hoshino makes no suggestion of connecting some of the coils together in pairs and connecting other coils directly to a receiver channel without combining it with another receiver coil.

Van Hellsbergen similarly fails to teach or fairly suggest combining the signals from different numbers of coils and connecting the signals from combined RF coils and non-combined RF coils to each of a plurality of receiver channels.

Accordingly, it is submitted that **claim 11 and claim 14 dependent therefrom** are not anticipated any reference of record.

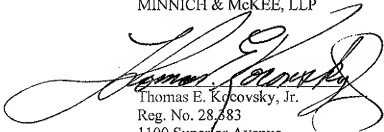
CONCLUSION

For the reasons set forth above, it is submitted that claims 1-14 (all claims) distinguish patentably over the references of record and meet all statutory requirements. An early allowance of all claims is requested.

In the event the Examiner considers personal contact advantageous to the disposition of this case, he is requested to telephone Thomas Kocovsky at (216) 861-5582.

Respectfully submitted,

FAY, SHARPE, FAGAN,
MINNICH & McKEE, LLP

A large, stylized handwritten signature in black ink, which appears to read "Thomas E. Kocovsky, Jr.", is written over the printed name and address.

Thomas E. Kocovsky, Jr.
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Invention Disclosure

This form and an annex containing a detailed description of the invention should be forwarded to Mr. Nico van Barschot, Tel. + 31 40 27 44306, Corporate Intellectual Property, building WAH, Prof. Holstlaan 6, 5656 AA Eindhoven, The Netherlands. nico.van.barschot@philips.com.

Names and first names of the inventors. J.S. van den Brink	Sal. nr./ empl. nr. 39120406	Building/Place/Tel. QR/0356/64863 / / / / / / / /	Ref.no. 635 Business Unit AMS-MR Dept. Head/Group Leader Patent coordinator/Contact person M. WOLFS	Date: [Redacted] - 01
To be filled in by Corporate Intellectual Property PE: XXXXXXXXXX M. WOLFS		Date: [Redacted] 2001	ID-number ID no. 207790 10 = to be filed 20 = rejected 40 = to be published	
Title of the Invention Magnetic Resonance Receiver Coil Topology Optimisation for SENSE				

Summary of the invention: Please attach a description in English.

In a Magnetic Resonance Device where the number of receive paths (channels) is less than the number of elements in a multi-element receive coil, optimal combination topologies and strategies are proposed
Description of the invention on annexes; please describe preferred embodiments and their advantages over prior solutions in detail; please include drawings.

Stage and importance of the invention

- a. Stage of the invention?
- b. In what products, processes or systems could the invention be used?
- c. For which other business units of Philips could the invention have relevance?
- d. For which competitors of Philips could the invention have relevance? Why?

- ☐ Research ☐ Pre-development
- ☒ Development ☐ (trial) manufacture
- Magnetic Resonance Imaging
- none
- GE, Siemens, Toshiba, MRI Devices, MAI

Distribution of information concerning the invention

When, how and where will information concerning the invention be distributed outside Philips? Please consider publications, hearings, exhibitions, offers, contacts with potential customers or suppliers, issuing of samples.

It has been communicated with Dave Molyneux from MRI Devices under Non-Disclosure Agreement during his visit to Best for an investigation of potential OEM relationship.

B. Even after sending this Invention Disclosure to Philips Corporate Intellectual Property, any such acts will impair patentability of the invention. Please contact Philips Corporate Intellectual Property before information concerning the invention leaves Philips.

Supplemental information concerning the invention

- a. Is the invention the result of a cooperation with persons outside Philips?
- If so, with whom?
- b. Is there, or will there be, an internal report on the invention? If so, please state the number.
- c. Are there, or will there be, other invention disclosures relating to this invention? If so, please state Ref.no.
- d. Are there other persons who could give information on the invention? If so, who?

yes (I got the idea while looking at the MRI Devices coil's image quality, and suggested a solution)
Dave Molyneux (MRI Devices)
not foreseen yet

yes

ID 604166
yes (?)

Paul Harvey

Recommendation management / patent coordinator as to urgency, commercial importance, and competitors' activities.

on line. [Signature]

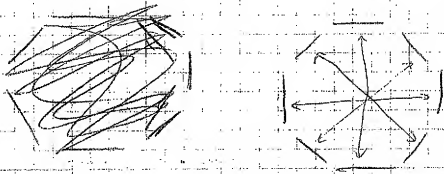


PHILIPS

Derwerp: SENSE coil optimal array configuration

This idea relates to ID 6041.66

It has been triggered by a contact with MRI Devices on their SENSE head coil. They have an 8-element head coil, which 8 elements are mapped to 4 channels by combining the opposite elements, i.e.



This combination is very non-optimal for SENSE as points in space that have to be unfolded when applying the SENSE reduction are encoded in one single channel.

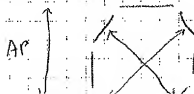
For our current system, the 8 elements should be mapped onto 6 channels. The insight (partially covered by

ID 6041.66) is that one should have as much individuality as possible along the preferred, ~~or~~ ^{AP} actual, SENSE reduction direction(s). This is first specialized here, and also general:

For brain imaging the SENSE reduction directions are most left-to-right ^{LR} or anterior-to-posterior ^{AP}.

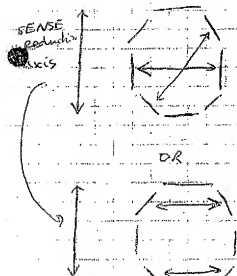
One possibility for mapping 8-to-6 for the configuration of 8 elements around the head would be to combine the oblique ones

and to keep optimal unfolded along the AP and LR axes



Onderwerp: SENSE coil optimal array configuration

II The second possibility would be a selection mechanism as described in 604166, where the combination is optimized depending on the actual SENSE reduction direction, e.g.



This one is asymmetric, which could be advantageous when considering phase behaviour.

This one is more symmetric. Coupling needs to be minimized within and across the residual elements. The combined elements are orthogonal to the reduction axis.

In more general terms, the individual coil array elements must be aligned as much as possible along the SENSE reduction axis. In the head, where the imaging plane is often tilted some 20° around the LR axis, the elements covering AP must be in-line with this orientation. In applications like cardiac imaging the individual elements should ^{optimally} cover the most common slice positions in the heart, like short axis, long axis and 4-chamber views and their respective fold-over, as SENSE reduction direction.